

PHARMACOGNOSTICAL STUDIES ON *JIVANTI* PART II—*LEPTADENIA RETICULATA*
WIGHT AND ARN. (SYN. *GYMNEMA AURANTIACUM* WALL.
EX HOOK. F. AND *ASCLEPIAS TUBEROSA* ROXB.)

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ABSTRACT

The present paper deals with the macro- and microscopical studies of all the vegetative parts of *Leptadenia reticulata* W. & A. alongwith physical constants and fluorescence characters of the drug.

The present paper, in continuation of author's pharmacognostical studies on *Jivanti* taking *Desmotrichum fimbriatum* Bl. (Fam. Orchidaceae) in the first part (Gupta *et al.* 1970), deals with studies on *Leptadenia reticulata* W. & A. The plant is much branched, leafy, twining shrub, flowers May-July, growing in sub-Himalayan tracts of Punjab and U.P. and throughout the Deccan Peninsula upto an altitude of 900 m on hedges. It occurs in Ceylon, extending to Burma and the Malaya Peninsula. The drug is known by different names in different part of the country (Hooker, 1885; Kirtikar and Basu, 1933; Anonymous, 1962; Haines, 1961).

Besides possessing stimulant and tonic properties the plant is used in nose and ear troubles. The leaves and roots are employed in skin infections and wound. The leaves are useful in asthma and cough also. (Anonymous, 1962; Chopra *et al.* 1956; Kirtikar and Basu, 1933; Sharma, 1956). The alcoholic extract (50%) of root and leaves show antimicrobial activity. Intravenous administration of aqueous extract of the stem has a pronounced and prolonged hypotensive action in anaesthetised dog appears to be non-toxic. The plant has been clinically tested and was found useful in the treatment of habitual abortion of women (Patel and Dantwala, 1958; Agrawal, 1960; Mangeshkar, 1958). Basu *et al.* (1968) have studied its antifertility activity.

The drug has gained attention to some extent from chemical point of view (Murti and Seshadri, 1944; Mukerjee and Srivastava, 1951; Verma and Agrawal, 1962; Rao and Malviya, 1966; Subramanian 1968).

However, there seems to be no account available in the pharmacognostical field excepting those of Balwant Singh (1943) and Rao and Malviya (1966) relating to the study of the intra- and interxylary phloem in the stem and laticifers in the plant. How-

ever, their work is mainly confined to the anomalous structure of the stem and distribution of laticifers and nature of the latex, without taking into consideration the distinguishing pharmacognostical characters. In the present pharmacognostical investigation detailed macro- and microscopical observations have been made on all vegetative parts. Percentage extractives (alcohol and water soluble) and ash value were determined. Recourse was also taken to investigate the fluorescence characteristic of drug powder.

MATERIAL AND METHOD

Fresh specimens of the whole plants of the drug were obtained from local collection and preserved in 70% alcohol. Free hand and microtomic sections were taken, stained and mounted. Cell-wall structure and cell-contents were studied according to the procedure described by Kay (1938), and Johansen (1940). Fluorescence characteristics exhibited by powders of the drug, were noted according to the method of Chase and Pratt (1949). The isolated elements of different tissues were studied after macerating them in Schultz's fluid. The quantitative values of the leaves were determined as described by Wallis (1948). The percentage of alcohol and water soluble extractives were also noted according to the I.P. (Anonymous, 1966).

MACROSCOPICAL CHARACTERS (Figs. a, b, c)

Root (Fig. b): The plant has tap root system. The tap root is quite long and thick, having a few daughter roots which are comparatively thinner. In commerce the root samples consist of pieces varying from 3 to 10 cm in length and 1.5 to 5 cm in diameter. There are remnants of rootlets at places on the external surface which is somewhat smooth in fresh young root, while in mature root, surface is rough due to the presence of longitudinal ridges and furrows. The ridges run almost vertically in slightly

zig-zag manner, anastomosing with neighbouring wrinkles. On drying, the furrows become more pronounced and transverse cracks appear at places throughout the length. They possess white, buff or slightly brownish exterior with no perceptible odour or taste. The fracture is short in bark region



Figs. a-c: Macroscopic structure of *Leptadenia reticulata* W. & A.

a. A twig with leaves and flowers. b. A dried root-piece with a portion of bark removed. c. A dried piece of stem.

and fibrous in wood. A transversely smoothed surface shows thin bark adhering to comparatively very thick wood. Phlorogucinol and Hydrochloric acid reacts red with cork, stone cells and lignified wood while iodine solution gives blue colouration with starch present in parenchyma of bark and wood.

Stem (Fig. c): The mature stem, after formation of cork, shows an ash coloured or buff white exterior with vertically elongated lenticels and whitish, smooth interior. The anastomosing vertical ridges and furrows with transverse cracks make external surface very rough. As the stem gets older the ridges and furrows become more prominent. Fresh bark gives camphoraceous smell which becomes unper-

ceptable in dry samples. Other characters are alike to root.

Leaf (Fig. a): Leaves are thin, sub-coriaceous; blade 1 to 3 inches long, ovate, oblong, or some lanceolate, with very obtuse or rounded or subcordate base; shortly hairy beneath or pubescent with rather curly hairs or glabrous, often hirtellous above. Petioles slender divaricate $1/2$ to 1 inch long. In dry condition leaves give yellow-brown appearance, no perceptible fragrance and taste; thick leathery rough texture due to the presence of hairs on the surface.

MICROSCOPICAL CHARACTERS

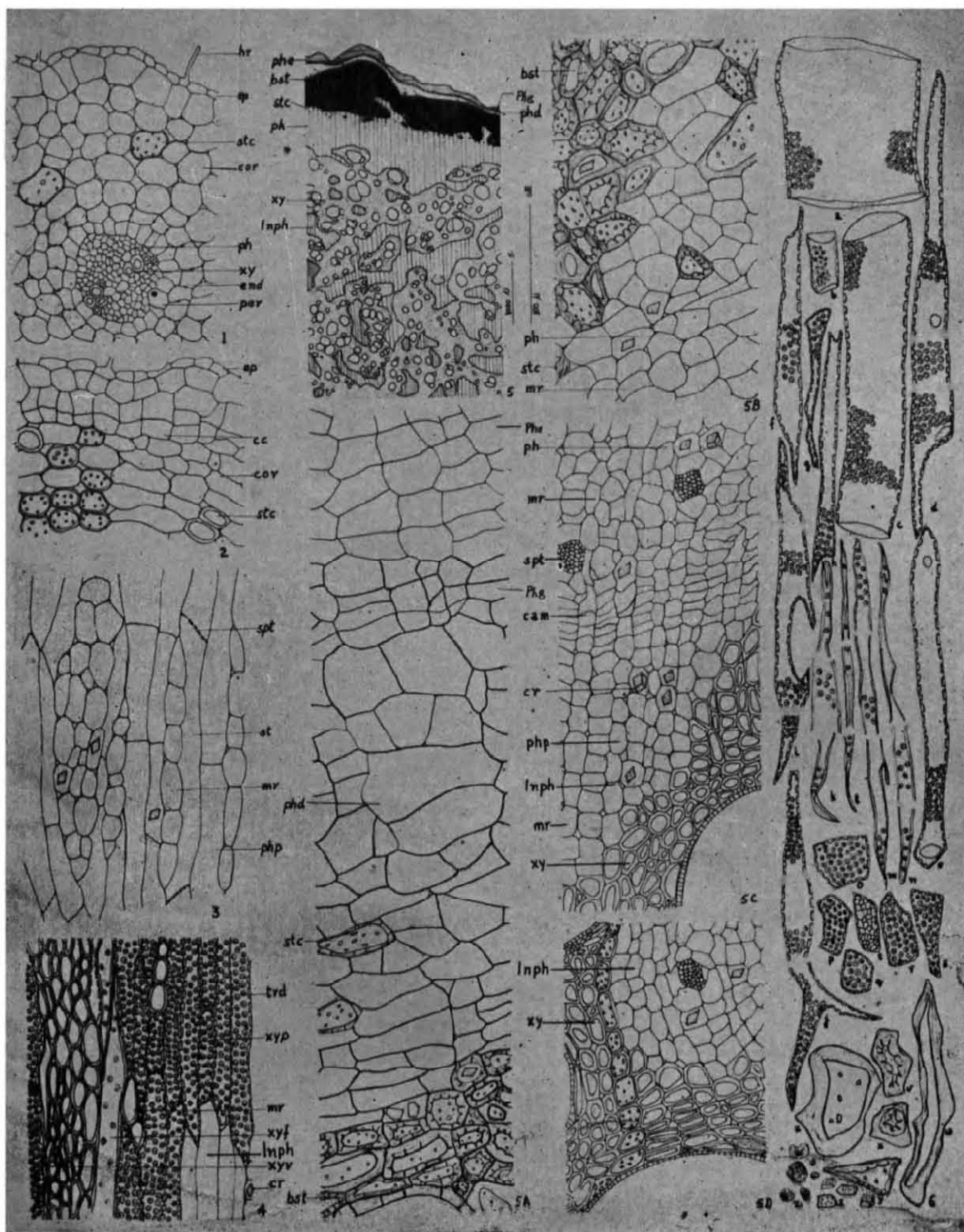
Young root (Figs. 1, 2): The cross-section of a young root shows a single layered epidermis of thin-walled, small cubical cells, followed by a cortex composed of 5 to 6 layers of parenchyma having distinct inter cellular spaces and a few stone cell forming idioblasts marked by their walls slightly thickened and pitted (Fig. 1). The innermost cortical layer is differentiated as endodermis. The endodermis is characterised by the presence of Casparian dots on their anticlinal walls. The single layered pericycle within the endodermis encloses a tetrarch stele (Fig. 1).

The secondary growth starts quite early in the normal way and soon a circular solid cylinder of secondary xylem surrounded by secondary phloem is formed. Later on small segments of cambium begin to function abnormally and produce strands of phloem tissue towards the secondary xylem. But after some time these segments resume their normal activity, producing the usual secondary xylem elements. This process is repeated a large number of times, giving rise to 'islets' of interxylary phloem embedded in the wood (Fig. 5). These strands of phloem consist of small groups of sieve tubes and companion cells in the centre surrounded by thin-walled phloem parenchyma (Fig. 5D).

The phellogen arises in the second layer of cortex and produces periderm [phellem out side and phel-loderm inside (Fig. 2)].

With the increase of secondary tissue, almost all the cortical cells gradually convert into stone cells, forming a band of variable thickness around the secondary phloem. Some cells of inner phel-loderm and outer phloem also form stone cells, giving additional thickness to this band.

Mature root (Figs. 3 to 6): A cross section of the mature root shows a wide cork composed of more or less rectangular to polyhedral cells. The cells have

Figs. 1-6: Microscopic structure of root of *Leptadenia reticulata*

1. A portion of T. S. of young root showing primary structure. 2. A portion of T.S. of bark of young root showing stone cells in the cortical region and cork formation. 3. Tangential section through inner region of mature bark. 4. Tangential section through wood. 5.T. S. (diagrammatic) of a portion of mature root. 5A. Details of periderm and outer portion of band of stone cells. 5B. Inner portion of band of stone cells and outer phloem region. 5C. A portion of inner phloem and outer wood. 5D. A portion of inner wood showing interxylary phloem. 6. Isolated elements. a-e, vessels; f-k, tracheids; l-n, fibres; o-t, xylem parenchyma; u-y, stone cells; z, calcium oxalate crystals. zl, starch grains.

bst, band of stone cell; cam, cambium; cc, cork cambium; cor, cortex; cr, calcium oxalate crystals; end, endodermis; ep, epidermis; hr, hair; lnph, interxylary phloem; mr, medullary ray; per, pericycle; ph, phloem; phd, phelloderm; phe, phellem; phg, phellogen; php, phloem parenchyma; st, sieve tube; spt, sieve plate; stc, stone cell; trd, tracheid; xy, xylem; xyf, xylem fibre; xyp, xylem parenchyma; xyv, xylem vessel.

thin-walls which show slight lignin reaction. They measure 25-41-62-82 by 21-28-37-49 μ . The position of the phellogen is not very clear throughout the periderm, however, it is marked at certain places in between phellem and phelloderm. The phelloderm is comparatively narrower zone consisting of polyhedral, rectangular to tangentially elongated cells, measuring 25-41-74-119 by 12-29-57-94 μ . In the innermost region there are some lignified stone cells also (Fig. 5A). Following this region is a broad band of stone cells, represented by the inner phelloderm, primary cortex and outer phloem tissue which are sclerised (Figs. 5, 5A, 5B). The sclerieds are yellowish, usually with striated and pitted walls, variable in shape from round oval, polyhedral to tangentially elongated and are of different dimensions, measuring 20-57-86-127 by 16-41-62-86 μ .

The inner region of secondary phloem (Figs. 5, 5B, 5C), occupying a narrow zone, is unligified, composed of traversing rays and greater amount of parenchyma in which small patches of sieve tubes and companion cells are distributed here and there. Sieve tubes are, sometimes, marked by the well developed sieve plate, and slightly thicker walls than those of neighbouring cells. Phloem parenchyma have small intercellular spaces and in the outer region, they are, not easily distinguishable from those of phloem rays. However, in the inner region, the parenchyma are well differentiated from those of ray cells which are radially elongated, whereas former is somewhat isodiametric (Figs. 5B, 5C).

A tangential section through middle phloem region (Fig. 3) shows sieve tubes with well developed sieve plates, obliquely placed at the end, companion cells, phloem parenchyma and uni- to bi-seriate ray. Multiseriate rays are also occasionally present. The uni- and bi-seriate rays are 1-4-8-14 cells high, whereas the multiseriate rays are 4-6-8 cells wide and 14 to more than 32 cells high. The individual ray cells measure 14-29-74-131 by 8-16-25-37 μ .

The phloem portion is delimited from the wood by 1-4 layers of thin-walled, rectangular and tangentially elongated cells of the cambium (Fig. 5C).

The secondary wood is a wide zone possessing lignified xylem tissue and unligified interxylary phloem, traversed by rays (Figs. 5, 5C, 5D). The 'islets' of interxylary phloem formed in the older and inner portion of the wood are smaller and fewer in number, while those formed in the outer portions are considerably larger and more in number (Fig. 5). These "islets" of phloem tissue consist of

small groups of sieve elements, surrounded by phloem parenchyma (Figs. 5C, 5D).

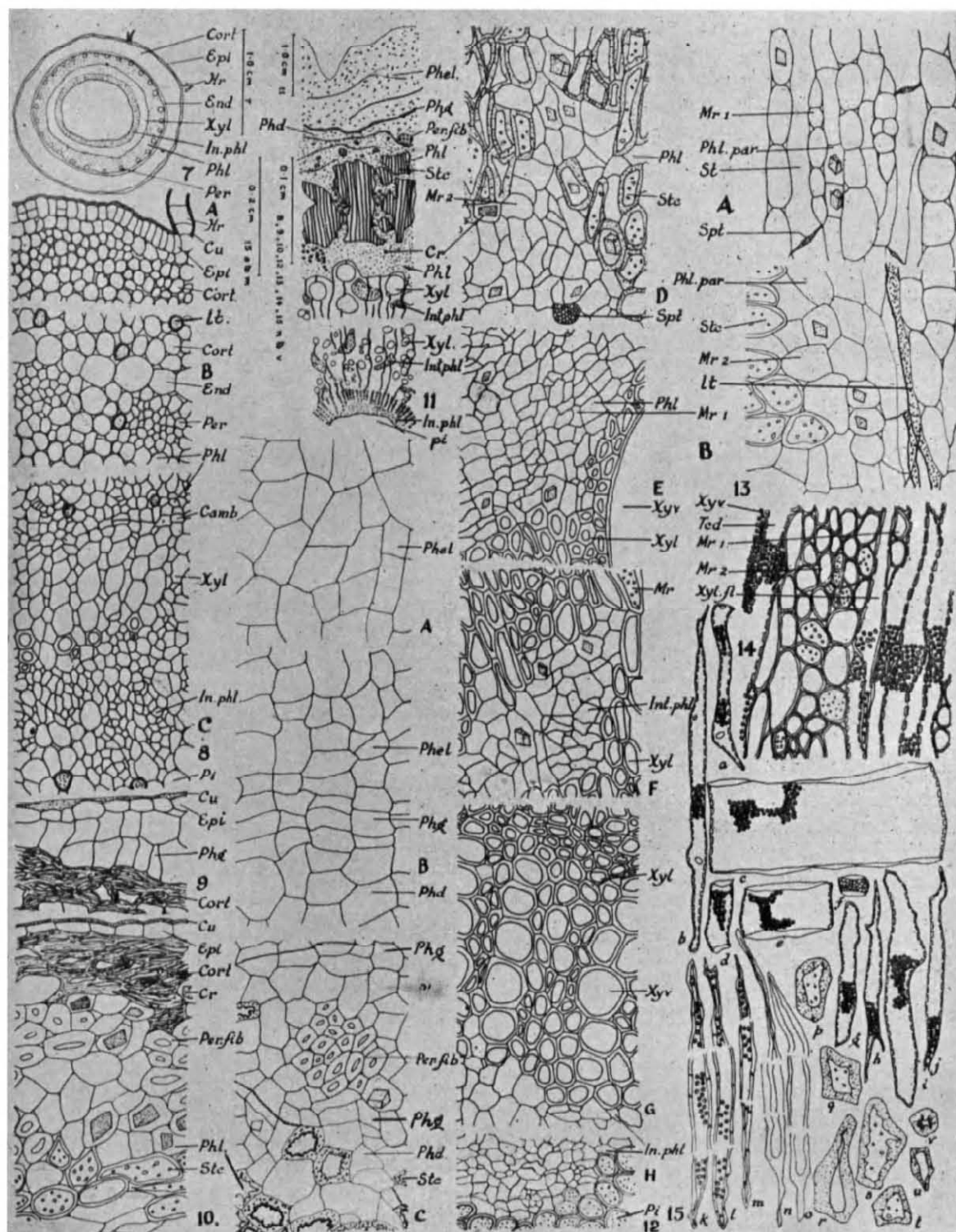
The lignified xylem tissue are composed of vessels, tracheids, fibres and parenchyma. The vessels are distributed singly or at places in groups of two to four (Fig. 5). In a macerated preparations, the bigger vessels are drum shaped and of shorter length measuring 171-247-297-363 μ in length and 82-132-247-330 μ in diameter (Fig. 6a). The narrow and elongated types measure 297-412-528-721 by 25-33-50-82 μ (Figs. 6c-e). Some appear like parenchyma (Fig. 6b) are of very short dimension measuring 24-41-61-82 by 17-25-32-41 μ . The latter ones are mostly reticulate type and bordered pitted type are occasionally seen. Other types of vessel are only bordered pitted. The tracheids (Figs. 6 f-j) are bordered pitted, elongated with slightly tapering pointed or bunt ends, some have side outgrowths also. They measure 148-328-492-791 by 12-21-30-33 μ . The fibres (Figs. 6 k-n) are greatly elongated with tapering and pointed ends and having bordered pits on their walls. Some have slightly peg like outgrowths or ends bifurcated. They measure 264-627-825-1353 by 12-16-24-33 μ . The xylem parenchyma (Figs. 6 o-s) has reticulate and bordered type of thickening measuring 35-45-63-72 by 14-20-26-36 μ .

The wood is traversed by medullary rays which are uni-, bi- and multiseriate. The tangential section through wood (Fig. 4) shows uni- and bi-seriate rays which are 2-4-5-8 cells high. The multiseriate rays are 4-8 cells wide and 18 to more than 36 cells high. The individual ray cells measure 12-33-45-62 by 8-16-21-29 μ .

Young stem (Figs. 7-10): A cross-section of the young stem shows a single layer of epidermis composed of cubical cells of small dimension. A large number of epidermal cells elongate and form multicellular, uniseriate, covering trichomes (Fig. 7B). These hairs are usually 5 to 7 celled, but some times upto 9 celled, attaining lengths 390-895-1260-1885 μ . They are covered with striated cuticle.

Below the epidermis is the cortex, usually 8 to 10 cells wide, the cells being thin-walled, parenchymatous, polyhedral to circular with small intercellular spaces. The endodermis is not distinct at a very young stage but is soon demarcated as distinct layer surrounding the stele (Figs. 8A, B).

Small patches of thin-walled, polyhedral parenchymatous cells, separated by groups of large parenchymatous cells, compose the pericycle (Fig. 8B). The

Figs. 7-15: Microscopic structure of stem of *Leptadenia reticulata*

7. T. S. (diagrammatic) of young stem. 8. A portion of T. S. of young stem showing details of 7. 9. A portion of T. S. of young bark showing phellogen formation. 10. A portion of T. S. of young bark showing collapsed cortex, pericyclic fibres and stone cell formation. 11. T. S. (diagrammatic) of a portion of mature stem. 12. Details of 11. 13A. Tangential section passing through inner phloem region. 13B. Tangential section passing through outer phloem region. 14. Tangential section passing through lignified wood. 15. Isolated elements. a-f, vessels; g-j, tracheids; k-m, xylem fibres; n-o, pericyclic fibres; p-v, stone cells.

Camb, cambium; Cort, cortex; Cr, calcium oxalate crystal; Cu, cuticle; End, endodermis; Epi, epidermis; Hr, hair; In. phl, intraxylary phloem; Int. phl, Interxylary phloem; Lt, lenticifer; Mr. 1, Uni-biseriate rays; Mr. 2, multiseriate rays; Per, pericycle; Per. fib, pericyclic fibres; Phd, phellogen; Phl, phellem; Phl. par, phloem parenchyma; Pi, pith; Spt, sieve-plate; St, sieve tube; Stc, stone cell; Tcd, tracheid; Xyl, xylem; Xyl. fi, xylem fibre; Xyv, xylem vessel.

thin-walled, small sized cells of pericyclic strands get thickened and lignified forming fibres (Fig. 10). The phloem (Fig. 8c) is represented by small strands of sieve-tubes, companion cells and phloem parenchyma. The cambium is represented by 2-3 layers of rectangular, thin walled cells which become continuous. The xylem, (Fig. 8c) which is represented in a very young stem by a few vessels, become compact later on. It is followed by intra-xylary phloem (Fig. 8c), which is located, as a slightly larger group than the normal phloem, at the periphery of the pith (Fig. 8c). The pith is represented by large, thin-walled isodiametric parenchymatous cells.

The laticifers are distributed in the pith, cortex and phloem region (Fig. 8) and are non-articulated. In the cortex and phloem region they usually occur near the pericyclic strands. The latex-tubes have thin-wall and are full of latex. In an adult plant they, however become more or less empty, and their walls become thick and slightly lignified.

The cambium produces secondary phloem on the outer side and secondary xylem on the inner side, giving rise to a continuous ring of wood. But, as the stem becomes older it shows the presence of 'islets' of inter xylary phloem in the wood (Figs. 11, 12 E, F). These phloem 'islets' are produced, as anomalous structures in the wood, in the same way as described in case of the root.

The pericyclic strands get more widely separated and form a discontinuous ring. The individual fibres are greatly elongated with tapering ends and thick-walls (Figs. 15 n, o) and they usually measure $2475-4125-5280-13695$ by $20-24-29-35\mu$. The parenchyma below the pericycle, in the outer phloem region, become sclerified (Figs. 10, 11) forming a band of stone cells. The process of stone cells formation remains continuous till the band becomes considerably thick.

The cork-cambium arises at certain places in the epidermis but generally in the outermost layer of cortex (Figs. 8, 9) and produces phellem above and phelloderm below. Further, rhytidome formation takes place in the phelloderm, owing to the formation of a number of cork-cambia in different regions of it. Sometimes a fresh phellogen which arises in the parenchyma below the pericycle starts cutting new layers of cork and thus these pericyclic strands reach quite away from the band of stone-cells.

The primary cortex become collapsed and form

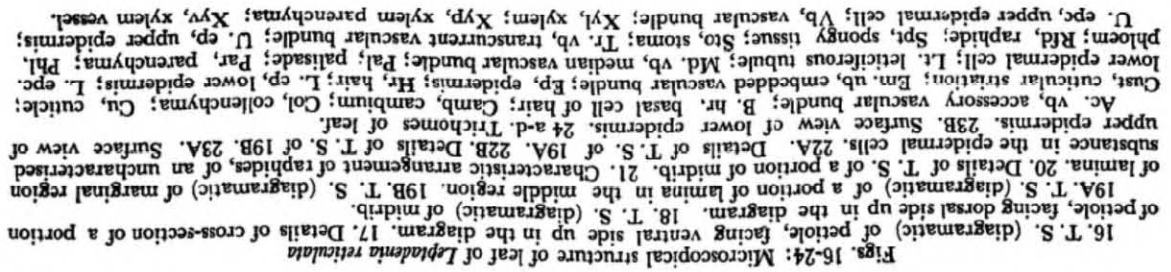
a band of crushed cortex (Figs. 9, 10), the position of which becomes indistinct in a considerably thick bark.

Mature stem: In a cross-section of mature stem, the outermost cork is represented by 10-20 layers of cork cells which are rectangular to polyhedral and most of them are more or less radially elongated, the cells measure $16-28-41-61$ by $20-28-41-53\mu$. The phelloderm consists of a large number of parenchyma and a few stone-cells, distributed singly or in small groups in the lower region. The rhytidome in the outer region, thus, includes only dead parenchyma and in the inner region parenchyma along with stone cells and strands of pericyclic fibres (Figs. 11, 12 B, C). The phelloderm cells measure $12-33-41-58$ by $28-36-49-78\mu$.

The periderm is followed by the phloem, the outer part of which is represented by a variably thickened band of stone-cells (Figs. 11; 12 C, D). In between the lignified zones, sometimes small patches of unligified phloem tissues are left (Fig. 12D). The stone cells are somewhat isodiametric elliptic and rectangular in the outer regions of the band and measure $16-29-41-62$ by $12-25-33-41\mu$, which, in the inner region, are rectangular to elliptic and are mostly radially elongated, measuring $25-33-45-78$ by $16-21-33-50\mu$. A tangential section through this region shows ray cells and phloem parenchyma gradually converting into stone cells (Fig. 13B).

The inner layers of phloem are unligified and occupy a narrow zone. They are composed of greater amount of parenchyma, a few sieve-tubes and companion cells and traversing rays. The laticiferous tubules (Fig. 13B) are distributed usually in the outer regions of it. They occur singly or in groups of two and possess slightly thick-wall. The cells of the outer phloem region are quite large as compared to that of the lower region. The sieve tubes which are usually accompanied by one or two companion cells are present rarely in the outer region and abundantly in the inner region. The phloem parenchyma possess similar structures as they have in case of root.

The rays are quite distinct in the inner region. They are mostly uni-seriate and seldom bi- to tri-seriate which become slightly dilated and multi-seriate in the outer region. The ray cells are radially elongated in the inner region but become slightly tangentially elongated in the outer region. In a tangential section through inner phloem region (Fig.



13A) the rays appear homogenous, their end cells, however, being slightly elongated. The uni-seriate rays are 2-5-7-9 cells high where as bi- and tri-seriate rays are 4-8-12 cells high. The multiseriate rays are about 4-6 to more than 10 cells wide and 11-32 to more than 50 cells high and are lignified in the lignified regions of wood. The cambium is a narrow strip of 2-3 layers of thin-walled rectangular cells.

Like root, the wood of stem shows the presence of interxylary phloem. The 'islets' formed in the older and inner portion of the wood are smaller and fewer in number than those formed later in the outer portions. These strands of phloem contain small groups of sieve tubes and companion cells in the centre surrounded by thin walled phloem parenchyma and are traversed by rays. In older stems these central cells become collapsed.

The xylem is composed of xylem parenchyma, large vessels, tracheids, and fibres (Figs. 15 a-m). All these elements are lignified and bordered pitted, however some of the xylem parenchyma show reticulate thickening also. The cells of rays, traversing the xylem, are thick walled, simple pitted and measuring 9-20-45-82 by 8-16-21-29 μ .

The uni- and bi-seriate rays (Fig. 14) are short ones. The former is 2-5-7-10 cells high and the latter being 5-7-9-12 cells high. The multi-seriate rays are very long ones being about 4-11-cells wide and more than 90 cells high. Other characters of different elements are similar to those present in root, however, they differ slightly in measurements which are given below:

The drum shaped, bigger vessels 280-340-400-450 and 200-290-380-576 μ . The parenchyma like smaller vessels 35-65-95 by 20-50-75 μ . The elongated, bigger vessels measure upto 288 μ with diameter about 20 μ . The tracheids measure 215-280-315-340 by 18-22-26-30 μ . The xylem fibres measure 280-415-600-725 by 20-24-28-32 μ . The xylem parenchyma are 35-45-63-72 by 14-20-36 μ in measurement.

The wood is followed by intraxylary phloem, most of cells of which are collapsed in a stem of considerable thickness. The cells of pith become thick-walled, slightly lignified and simple pitted (Fig. 12H).

Leaf petiole (Figs. 16-24): A transection of petiole represents almost a circular out line (Fig. 16). The epidermal cells (Figs. 17A, D) are small and cubical in shape, externally covered with ridged cuticle, measure 10-12-14-17 by 8-12-16-19 μ . Some of the epidermal cells are elongated to form uniseri-

ate, multicellular covering trichomes, being upto 11 cells long. They measure 247-330-412-1518 μ . The epidermis is followed by a wide zone of cortex (Figs. 16, 17). The outer 2-7 layers of which are collenchyma, measuring 16-21-29-33 by 16-21-25-29 μ and the rest of layers are parenchymatous. The parenchyma are mostly isodiametric with small intercellular spaces and measure 21-33-41-62 by 21-33-45-63 μ . The petiole receives three vascular bundles, large crescentic bundle in the centre and two smaller and some what circular accessory bundles flanking above on each side of the arms of the central bundle (Fig. 16). The xylem occupies the central position of each bundle, consisting of spiral and reticulate type of vessels, bordered pitted tracheids and simple pitted parenchyma. The phloem consists of sieve tubes, companion cells, and phloem parenchyma. The cambium is present between the phloem and xylem. Laticifers in singles are seen in the cortex and phloem region (Figs. 17 B, C). Their walls are slightly thicker than those of adjacent cells.

Midrib: The midrib represents a planoconvex structure (Fig. 18), the ventral side being almost plain. The epidermal cells are slightly smaller than those of petiole and measure 8-14-16 by 8-12-15 μ . They are covered externally by ridged cuticle (Figs. 20 A, C). Some of the epidermal cells elongated to form trichomes like those of petiole. They are upto 12 cells high, 7 to 9 celled being more common, and measure 418-1246-1845 μ in length.

On the ventral side near the centre (Fig. 18) below the epidermis is occupied by 2-4 layers of collenchyma (Fig. 20A) followed by parenchyma, while in the rest of portion, towards the arm, the palisade layers in continuation with mesophyll of rest of the lamina are present (Fig. 18). On the dorsal side there is usually one layer of collenchyma below the epidermis, excepting in the middle region where the collenchyma is 2 to 3 cells thick. The rest of ground tissue consists of parenchyma measuring 14-28-41-61 by 14-29-49-69 μ . The collenchymatous cells measure 12-21-25-33 by 16-20-22-5-33 μ . The vascular structure is represented by a crescent shaped bicollateral vascular bundle (Figs. 18, 20B) consists of usual elements of xylem and phloem described in case of petiole. The laticifers are distributed in the phloem region and in the ground tissue near by vascular bundle (Fig. 20B). Their walls are thin.

Lamina: The lamina presents a dorsiventral structure (Figs. 19 A, B). The epidermal cells (Figs.

22 A, B) on the both surfaces are cubical to tangentially elongated in shape. The upper epidermal cells, however, are larger in dimension (25-41-57-70 by 20-29-40-41 μ) than the lower epidermal cells (20-25-29-33 by 20-22.5-27-29 μ). In surface view the upper epidermal cells are polyhedral with more straight walls than those of lower epidermis (Figs. 23 A, B). The epidermal cells are covered externally with a thick cuticle on the both surfaces. The cuticle is striated and appear to diverge in various direction from the outer dentate wall of guard cells of stomata and basal cells of trichomes (Figs. 23 A, B). A number of epidermal cells elongate to form long bulbous trichomes. The bulbous basal cells of the trichomes are quite large, measuring 36-44-49-62 by 36-45-49-66 μ , being surrounded by 12 to 15 epidermal cells (Fig. 23A). The body of hairs consist of 4 to 6 cells, but in the neural region, they are quite long, upto 14 cells. A few cells become collapsed in the middle region in some of the trichomes (Fig. 21). The trichomes measure 332-740-1490-2910 μ in length. The stomata are slightly shunken, measuring 16-18-22-28 by 14-16-20-22 μ and are more numerous on the lower surface than those of the upper surface (Figs. 23A, B). They are mostly rubiaceous and to some extent ranunculaceous type (Fig. 23 B).

The upper epidermis is followed by 2-3 layers of

palisade cells (Fig. 22A), measuring 25-37-45-62 and 10-12-16-21 μ . They are arranged rather in a compact manner. Below the palisade layer, loosely arranged mesophyll cells constituting the spongy tissue are present (Fig. 22A). At certain places, the cells of mesophyll, below the lower epidermis, present palisade like appearance particularly in the marginal region (Fig. 22B).

Running through the mesophyll are found bigger and smaller veins in various planes. The veins are mostly embedded but the larger ones are usually transcurrent (Figs. 19, 22A). The bigger veins show phloem surrounding either the whole of the xylem (Fig. 22A), or dorsiventrally or only dorsally in the case of smaller veins. Digitate vessel ending, unaccompanied by phloem are present in the marginal region between palisade and spongy tissue (Fig. 22B). Towards the marginal region some of the mesophyll cells become thick-walled appear as collenchyma (Fig. 22B). The laticifers are present only near the veins and vein-lets (Fig. 22B).

QUANTITATIVE VALUES

The leaves were subjected to quantitative determinations *viz.* palisade ratio, stomatal index, stomatal number and epidermal cells count. Findings are given in Table I.

TABLE I

	LOCATION			Range of variation per leaf	Average value for species
	Base	Middle	Apex		
1. Palisade ratio	4-4.5-5-5.5	3-4-4.25-5	3.75-4.25-5-5.75	3-6	4.5
2. Stomatal index (Lower epidermis)	5-5.5-6.7-8.4	4.8-7-8.1-9	7.5-8.3-9.4-10	5-10	6.72
3. No. of stomata/sq. mm (Lower epidermis)	16-17-18-20	16-17-20-22	20-22-26-28	16-28	16-20
4. No. of epidermal cells/sq.mm (Lower epidermis)	196-200-219-242	202-226-245-267	220-228-242-262	196-267	229.08
5. No. of epidermal cells/sq. mm (Upper epidermis)	153-164-174-183	134-147-160-180	142-162-188-205	134-205	166

Cell contents: Calcium oxalate crystals as rhomboids and prisms and starch grains are present in the phelloderm, phloem (normal and interxylary) and the medullary rays of the mature root and stem and also in the cortical cells of the young root and stem. These crystals are present singly or occasionally in groups of two in the cells and measure 16-21-25 by 12-16-21 μ . Sometimes they are seen in the stone cells of stem and root.

Starch grains are more abundant in the root. The

grains are simple and are of varying shape with distinct hilum in the centre. Leaves when preserved in 70% alcohol, an uncharacterised substance crystallises out in the form of raphides, in their epidermal cells (Fig. 22A), arranged in a particular manner as shown in Fig. 21. However, they are not seen in peelings of fresh leaves. The latex is present in the laticifers of young and moderately mature stems, branches, and leaves. The laticifers could not be seen in the root. In addition to these,

the alcoholic extract of young stems and leaves showed the presence of glycoside, flavonoid and reducing sugar and sterol whereas in mature stem and roots only reducing sugars and sterols could be detected. Tannins, alkaloids were found absent in all the parts.

EXAMINATION OF DRUG POWDER

The colour of the powder is greenish yellow and taste slightly bitter. The histological elements to be observed microscopically include small fragments of leaves showing epidermis with rubiaceous to some extent ranunculaceous stomata and characteristic cuticular striations on the epidermal cells; broken parts of trichomes; small groups of cork cells and perenchyma; isolated or small groups of stone cells, fibres, tracheids and vessels. The starch grains of different shapes and sizes and prismatic crystals of calcium oxalate are also seen.

FLUORESCENCE ANALYSIS

Powders of the root, the stem and the leaves were examined under ultraviolet light and the fluorescence characters were recorded in the Table II.

TABLE II

Treatment	FLUORESCENCE			
	Root	Stem	Leaf	Whole plant
Powder as such	Light blue	Ash colour	Dark green	Bluish Green
Powder treated with 0.1N NaOH in methanol	Green	Greenish yellow	Brown	Greenish yellow
Powder treated with nitrocellulose	Green	Dirty orange	Red	Pink
Powder treated with 0.1N NaOH in methanol and mounted in nitrocellulose	Green	Light green	Dark brown	Yellowish green

Physical constants: Physical constants such as alcohol and water soluble extractives and ash values were determined and findings are given in Table III.

TABLE III

	Root	Stem	Leaf	Whole Plant
Alcohol soluble extractive	2.46%	1.41%	9.2%	5.22%
Water soluble extractive	5.07%	4.3%	41.62%	19.706%
Ash value	5.26%	6.32%	13.76%	9.70%
acid insoluble ash	0.206%	0.515%	0.923%	0.625%

A

DISCUSSION

Jivanti is a noted drug of Ayurveda. The correct identity of this drug, however, is not ascertained. Besides the plants reported earlier (Gupta *et al.*, 1970), some more plants *viz.*, *Coelogyne ovalis* Lindl. (Fam.—Orchidaceae), *Dregea volubilis* Benth. and Hook. f. and *Sarcostemma brevistigma* Wight, belonging to family Asclepiadaceae are also in use as *Jivanti* (Dutt, 1922; Bhandari, 1948; Swami, 1936). Owing to the insufficient description of identifying characters, in the old treatise of Ayurveda, the problem has become more confusing.

The present investigation has clearly brought out all the diagnostic macro-and micro-characters of root, stem and leaf including the quantitative values, percentage extractives, ash values and fluorescence characters by which the drug *Leptadenia reticulata* W. & A. may be easily distinguished from other plants used as *Jivanti*.

The occurrence and development of interxylary phloem in the root and intra- and interxylary phloem in the stem has been studied. The latter, has been discussed by Balwant Singh (1943) whose findings relating to the mode of formation of these 'islets' of interxylary phloem support the observation made in this investigation in all essential details.

The observations have been made regarding the presence and distribution of laticifers in the stem and the leaf and absence of the same in the root, which are significantly more in the favour of earlier work (Rao and Malviya 1966).

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*Not seen in Original.